

**REMARKS**

Claims 1-20 are all of the claims presently pending in the present Application. Claims 1-6 have been amended to more particularly define the invention. Claims 7-20 have been added to claim additional features of the invention.

It is noted that the claim amendments herein are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims, or for any statutory requirements of patentability.

Further, it is noted that, notwithstanding any claim amendments made herein, Applicants' intent is to encompass equivalents of all claim elements, even if amended herein or later during prosecution.

Applicant gratefully acknowledges the Examiner's indication that claim 6 would be allowable if rewritten in independent form. Applicant notes that claim 6 has been rewritten in independent form and is therefore, in condition for immediate allowance.

Claims 4-6 stand rejected under 35 U.S.C. § 112, second paragraph as being allegedly indefinite. Claims 1-5 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Fujikawa et al. (U.S. Patent No. 6,323,120).

These rejections are respectfully traversed in view of the following discussion.

**I. THE CLAIMED INVENTION**

The claimed invention (e.g., as recited in claim 1) is directed to a wiring structure for semiconductor device, which includes a wiring layer that includes copper as main component, and a crystal grain promotion layer that promotes enlargement in a crystal grain of the wiring layer.

Conventional wiring structures using a copper wiring are typically formed by a Damascene process in which a barrier layer is formed in a trench of a substrate, and the copper wiring is formed on the barrier layer (Application at Figure 1B; page 2, line 7 -page 3, line 20). However, the barrier layer must be thick which causes it to increase the resistivity of the wiring.

The claimed invention, on the other hand, includes a crystal grain promotion layer that promotes enlargement in a crystal grain of the wiring layer (Application at page 8, lines 5-21). The inventors found that the **size** of the crystal grain of the wiring layer may be enlarged by the existence of the crystal grain promotion layer, and therefore, a wiring (e.g., a nano-scale copper wiring) having a low resistivity and high reliability can be realized (Application at page 4, lines 23-25; page 6, lines 5-6).

## **II. THE 35 U. S. C. §112, SECOND PARAGRAPH REJECTION**

The Examiner alleges that claims 4-6 are indefinite. Applicant would point out, however, that these claims have been amended to replace "crystal grain layer" with "crystal grain promotion layer", to address the Examiner's concerns.

In view of the foregoing, the Examiner is respectfully requested to withdraw this rejection.

## **III. FUJIKAWA**

The Examiner alleges that Fujikawa teaches the claimed invention of claims 1-5. Applicant submits, however, that there are elements of the claimed invention which are neither taught nor suggested by Fujikawa.

Fujikawa discloses a method of forming a wiring film, which includes forming a barrier layer 3 on an insulation film 2 having a hole 2A, forming a **copper seed layer** on the barrier layer and laminating a wiring film 5A by electrolytic plating, and heat treating the structure at high temperature and pressure (Fujikawa at Abstract).

However, contrary to the Examiner's allegations, Fujikawa does not teach or suggest "*a crystal grain promotion layer that promotes enlargement in a crystal grain of the wiring layer*", as recited, for example, in claim 1.

As noted above, the inventors found that the **size** of the crystal grain of the wiring layer may be enlarged by the existence of the crystal grain promotion layer, and therefore, a wiring

(e.g., a nano-scale copper wiring) having a low resistivity and high reliability can be realized (Application at page 4, lines 23-25; page 6, lines 5-6).

Clearly, these novel features are not taught or suggested by Fujikawa. Indeed, the Examiner attempts to equate the seed layer 4 in Fujikawa with the crystal grain promotion layer in the claimed invention. This is clearly unreasonable.

In fact, the seed layer 4 in Fujikawa is formed of "a metal material made of copper or copper alloy identical with the wiring film 5". That is, the seed layer 4 is merely intended for "seeding" and is not intended to enlarge the crystal grain (e.g., the size of the crystal grain) of the copper layer 5.

Applicant would point out that Fujikawa refers to Figure 1a and states that when a heat treatment is applied "in a highly pressurized gas atmosphere", growing of crystal grains is promoted and a wiring film 5A having a larger crystal grain size "compared with that of the wiring film generally heat treated at an atmospheric pressure can be obtained" (Fujikawa at col. 4, lines 52-62) (emphasis added). That is, Fujikawa merely teaches that a grain size of the wiring film may be larger at a higher pressure than at atmospheric pressure.

Indeed, **contrary to the Examiner's allegations, nowhere does Fujikawa teach or suggest that the seed layer 4 has anything at all to do with promoting an enlargement of the crystal grain of the copper film 5.** Therefore, it is completely unreasonable to attempt to equate the seed layer 4 in Fujikawa with the crystal grain promotion layer of the claimed invention, that promotes enlargement in a crystal grain (e.g., promotes enlargement of the size of the crystal grain) of a wiring layer.

Moreover, Applicant would point out that the objective of Fujikawa is to provide a wiring film having a fine crystal grain in order to provide a superplastic phenomenon. Fujikawa does not seek to provide an enlarged crystal grain (Fujikawa at col. 3, lines 44-52). Thus, the objective of Fujikawa is in complete contrast to the claimed invention which may see to enlarge a size of the crystal grain of the wiring layer.

Therefore, Applicant submits that there are elements of the claimed invention that are not

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taught or suggested by Fujikawa. Therefore, the Examiner is respectfully requested to withdraw this rejection.

### **III. FORMAL MATTERS AND CONCLUSION**

In view of the foregoing, Applicant submits that claims 1-20, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,



Phillip E. Miller  
Reg. No. 46,060

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**McGinn & Gibb, PLLC**  
8321 Old Courthouse Road, Suite 200  
Vienna, VA 22182-3817  
(703) 761-4100  
**Customer No. 21254**